

PLASTER OF PARIS (STUCCO) AS MIXING AID FOR AQUEOUS BITUMINOUS EMULSION AGGREGATE SLURRIES

BACKGROUND OF THE INVENTION

(1) Field of the Invention

The present invention relates to mixing-grade, quick-setting and slow-setting cationic aqueous bituminous emulsion-aggregate paving slurry seal mixtures. More particularly, the present invention relates to paving slurries formed with cationic and anionic emulsions prepared by emulsifying bitumen, such as an asphalt, in water with cation-active or anionic-active emulsifier and combining the emulsion with fine-grained aggregate.

The invention relates specifically to Plaster of Paris (Stucco, calcium sulfate hemihydrate) which is added to the slurry mix to extend mixing time at ambient and elevated temperatures and improve adhesion performance of the asphalt to the aggregate.

(2) Description of the Prior Art

Conventionally, emulsion slurry seals are formulated from (1) mineral aggregate which is a fine stone aggregate and/or mineral filler and (2) about 15% to about 25% by weight thereof of a mixing-grade, slow-setting emulsion containing from about 50% to about 75% by weight of bituminous residue (usually asphalt), with a further addition of about 5% to about 25% of water, based on the weight of the dry aggregate, to attain slurry consistency. Usually, densely-graded aggregates, such as granite screenings, limestone screenings, dolomite screenings and blast furnace slag, are combined with bituminous emulsions to produce slurry seal compositions. These aggregates range in size from anything passing all through a sieve of No. 4, and even No. 10 mesh, with from 15% to 20% passing through as fine as mesh as 200 mesh, as described in ASTM C136.

The advent of slurry seal as a paving and road maintenance technique was first developed for use with anionic aqueous bituminous emulsions. A slurry seal is an intimate mixture of emulsified bituminous material and fine-grained aggregate held in suitable suspension until applied to the road surface. The slurry seal emulsion must be of an oil-in-water type. In such a mixture with aggregate, the aqueous emulsion form of the bituminous material has been generally preferred because it is less hazardous and more economical to use than hot mix or cutback (solvent containing) asphalts. Further, the aqueous emulsion form can be stored, transported and applied at much lower temperatures, obviating the necessity of heating equipment to maintain a bitumen-aggregate system in a workable or usable form. While these advances have been recognized, widespread acceptance has not been achieved due to disadvantages found in previous aqueous bituminous emulsions.

More recently, cationic bituminous emulsions have come into use and eliminate many of the disadvantages of the earlier conventional anionic emulsions. Bituminous emulsions formulated using cationic emulsifiers do not "break" in the same manner as anionic emulsions, but rather the bituminous material is deposited from the emulsion due to the attraction of polar charges between the bituminous droplets and negatively charged aggregate surfaces. Thus, cationic bituminous emulsions deposit more rapidly than the anionic bituminous emulsions on aggregate surfaces and are bonded to the ag-

gregate by the electrostatic action at the interface of the bitumen and the aggregate material.

The aqueous cationic and anionic bituminous emulsions themselves are relatively stable, and the emulsion stability may be enhanced by various additives well known in the art. Most cationic bituminous emulsions, however, deposit on the surface of aggregate materials rapidly when aggregate is contacted with the emulsions. Bitumen from an aqueous cationic bituminous emulsion is deposited from the emulsion due to the charge attraction between the bituminous droplets and the aggregate materials. The rapid setting action of cationic bituminous emulsions is of considerable advantage in road building, such as seal coats, since the roads can be opened to traffic shortly after application of the coating. Although the rate of asphalt deposition, for example, from the emulsion can be controlled to some extent, the time required for complete deposition is never very long and it is therefore the practice to combine the cationic emulsion with the aggregate at the site of road construction, either on the surface of the road itself, or in a mobile mixer which permits the emulsion aggregate mix to be rapidly spread. Due to the charge attraction mechanism, the rapidity of deposition of bituminous materials from the cationic emulsion is closely related to the generally negatively charged surface area of the aggregate or filler material. Thus, while a specific cationic bituminous emulsion might provide suitable properties for use in conjunction with some aggregates, the same cationic emulsion may not exhibit suitable properties when used with very finely ground materials having vastly larger total surface area. The rapid deposition characteristics of the cationic bituminous emulsions frequently makes it impossible to use such emulsions with fine-grained aggregate in slurry form such as in gun application or spreader box application. Therefore, since the slurry seal should mix well, pump well, lay down well, not stiffen while being applied, and, after setting, wear well under traffic, it is particularly desirable to be able to control the setting time of the slurry for various aggregates employed.

Acidified polyamine condensates of certain polycarboxylic acids, anhydrides, sulfonated fatty acids and epoxidized glycerides with certain polyamines are suitable emulsifiers yielding asphalt emulsions which can be mixed with fine grained aggregate to give workable aggregate/emulsion mixes.

These types of emulsifiers are disclosed in U.S. Pat. No. 4,447,269 to Schreuders et al., U. S. Pat. No. 4,450,011 to Schilling et al., U. S. Pat. No. 4,547,224 to Schilling et al., U. S. Pat. No. 4,462,890 to Schilling et al., U. S. Pat. No. 4,464,286 to Schilling, and U. S. Pat. No. 4,597,799 to Schilling.

However, cationic emulsions produced with the emulsifiers can only be mixed with aggregates when the temperature of the emulsion or the aggregate is below 100° F or when the aggregate surfaces are only moderately charged. In hotter climates where the temperature of the mixes are as high as 120° F and when highly charged aggregates have to be used, these emulsions fail the mixing process.

Anionic emulsifiers, which are very versatile and which properties can be widely varied by changing of the pH-value of the corresponding soap solutions, are prepared by reacting the above described polyamine condensates with acrylic acid, metacrylic acid, fumaric acid, maleic acid, chloroacetic acid, formaldehyde and sodium sulfite and other reactive acids capable to substi-